**FINAL AGENDA**
NADP Spring Meeting
Joint Subcommittee Meeting
March 25-26, 2003

**Tuesday, March 25**

8:00-8:15  Introduction of Attendees and Agenda Overview  Nilles
8:30-9:10  NADP Program Office Report  Van Bowersox
9:10-9:40  CAL Report  Karen Harlin
9:40-10:00 Bag liner experiments  Karen Harlin
10:00-10:30 Break
10:30-11:00 MDN Report  Clyde Sweet
11:00-11:30 HAL Report  Bob Brunett
11:30-1:00 Lunch
1:00-5:00  Subcommittee Meetings
           Network Operations Subcommittee (NOS)  Mark Nilles
           Data Management Subcommittee (DMAS)  Bob Larson
           Effects Subcommittee  John Sherwell

**Wednesday, March 26**

8:00-8:30  YES Inc. Collector performance  Scott Dossett
8:30-8:45  Climate Reference network CD-ROM  Scott Dossett
8:45-9:10  Precipitation data-collocated NTN and MDN sites  Van Bowersox
9:10-9:30  N-CON version II MDN prototype collector  Mark Nilles
9:30-9:45  Ott Pluvio update, reports, software and telemetry  Mark Nilles
9:45-10:15 Break
10:15-11:00 Discussion: Testing & decisions for new equipment  All

11:00-11:30 Network QA Report            Chris Lehmann

11:30-1:00 Lunch

1:00-2:30 Urban site data utilization in NADP products
           and other Data subcommittee issues for joint session  Bob Larson

2:30-3:00 Break

3:00-4:30 Environmental effects agenda items joint session  John Sherwell

4:30-4:45 Other business

4:45-5:00 Straw poll for Spring 2004 Meeting and closing  Latysh

5:00 Adjourn
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<td>Karen Harlin</td>
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<td>Maggie Kerchner</td>
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The NADP Vision

- Remain one of the nation’s premier research support projects
- Serve scientists and educators
- Support informed decisions on air quality issues related to precipitation chemistry

Countries with Registered NADP Users

Registered NADP Users per Million People

Adverse effects of acid rain on the distribution of the Wood Thrush Hylocichla mustelina in North America

http://nadp.sws.uiuc.edu

Attachment 2, NADP Joint Subcommittee minutes, Spring 2003
USES OF NADP ISOTOPE DATA

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Quality Data?

What do we mean when we say:

"NADP provides quality assured data and information in support of research...."

Data Quality Objectives

MDN Sites

AeroChem Metrics Collector

YES Collector

N-Con Collectors
The NADP Vision

• Remain one of the nation’s premier research support projects
Attachment 2, NADP Joint Subcommittee minutes, Spring 2003

Western Association of Agricultural Experiment Station Directors

APPROVED FY03 BUDGET AND DEFERRED DECISION ON RENEWAL UNTIL ITS SUMMER MEETING IN JULY

National Atmospheric Deposition Program
National Trends Network

NADP/National Trends Network
1 September 2002

NADP/NTN Sites
Land Grant Universities
The NADP Vision

- Remain one of the nation’s premier research support projects
- Serve scientists and educators
- Support informed decisions on air quality issues related to precipitation chemistry
- Respond to emerging issues

Threats to air, water, and food
- Biohazard
- Toxic Chemicals
- Radioactivity

Active NADP/NTN Sites during the April 1986 Chernobyl Nuclear Power Plant Explosion

Radionuclides tested in NADP Precipitation Samples

Atmospheric Integrated Research Monitoring Network (AIRMoN) 1992

Trajectories based on NOAA Air Resources Laboratory HYSPLIT model

The NADP Vision

• Remain one of the nation’s premier research support projects
• Serve scientists and educators
• Support informed decisions on air quality issues related to precipitation chemistry
• Respond to emerging issues
• **Efficient measurement system**
Cumulative Precipitation from Three Different Types of Raingages (November 2001 - April 2002)

Statistic | Ott 1 | Ott 2 | P-value
--- | --- | --- | ---
Number of Events | 132 | 132 | 0.1831
Mean Precipitation (inches) | 0.2832 | 0.2832 | 0.1831
Median Precipitation (inches) | 0.1327 | 0.1327 |
Total Precipitation (inches) | 38.13 | 38.38 |

Paired t-test: Mean Difference = 0, p-value = 0.1831, Do Not Reject

Wilcoxon-signed-rank test: Median Difference = 0, p-value = 0.1831, Do Not Reject

Comparison of Three Gages (Ott [East], Ott [West], Bellfort) with the NWS Stick Gage: November 2000 - April 2002

Frequency of Environmental False Positives for Ott [East] & Ott [West]: Nov 2000 - Apr 2002
NOAH III Raingage Analysis

- Two identical raingages with optical sensors placed approximately 20 feet apart; identified as North (N) and South (S).
- Data divided into three groups: unfiltered, filtered, and filtered with step-down removed.

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<td>Unfiltered</td>
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<td>September 2002 – December 2002</td>
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<td>Filtered</td>
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<td>December 2002 – February 2003</td>
<td>17</td>
<td>Filtered with step-down on North gage</td>
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The NADP Vision
Support user needs
Central Analytical Laboratory (CAL) Report  
March 2003

**Site Operations**

NTN 250 active sites as of 03/20/03 (includes 2 collocated sites 02OR and 98WI)
10 new sites or 4% increase in 2002

AIRMoN 10 active sites (Note DE99 to become NTN site in 2003); 3 sites had ATS audit

Inventory required = 300 sampling supplies (buckets, lids, and 1-liter bottles)/wk

**2004 CALendar**

April site mailing will request submission of pictures and information
Deadline May 30
Ideas for this year’s theme are welcome
Distributed at the Fall Technical meeting and included in September site mailings

NTN training video “Every Tuesday Morning”
Digitized
Undergoing review by CAL staff prior to being distributed on CDs

**Laboratory Operations**

Samples received as of 3/21/03
NTN: 236,051
AIRMoN: 14,800

New instrumentation
Replace the 10-year old AAS for major cations (Na, K, Mg, Ca)
Targeted reduced volume (AAS requires 8 mL sample)
elimination or automated addition of modifier

Varian Vista Pro Inductively Coupled Plasma Optical Emission Spectrometer (ICP-OES) purchased
Lab preparations in progress
Expect install in May
Plans to conduct parallel analysis of AAS vs. ICP as referenced in “Flow Injection Analysis Method Validation Study”, Nov 1989

Optimization of nutrient methods
Source of standards, external check samples, and in-house sample handling

Total Nitrogen

Sulfate interference was found with Dionex sampler vials with filters (used for AIRMoN)
CAL experienced delays in ion chromatography analysis which the source of the interference was investigated. The problem was resolved after the source was identified. Only vials without filters are now used at CAL. AIRMoN samples are now decanted for IC analysis rather than filtered.

NADP NTN active archive and current (special) samples approved at the July 02 and Fall 2002 meetings have been shipped to researchers. AIRMoN archive sample distribution is pending. (See Program Office report)

AAS chemist (Bachman) retired Dec 2002

Site Operator Training Course

33rd Site Operation Training Course – April 8-10, 2003
2nd yr that special sessions for MDN and AIRMoN operator training are included. 30 have registered

NTN Site Operation Manual revisions
Revised Appendix A (NTN Equipment Requirements)–done
Revised Section 7 (contact information) –done
Appendix B (Troubleshooting pH and Conductivity Measurements) –final proofing
Revisions to be sent in site mailings this spring with a summary cover letter

On-site troubleshooting decal (new)
To aid in on-site evaluation of motor unit, sensor, or power supply failures
Developed and ready for distribution

NTN Lid Seal Change
Scheduled July 8, 2003
Purchase a 1-year supply this year to deplete inventory pending new collector design
CSU can provide lid seals for new collectors
June 4, 2002; 95% returned, no unusual problems
QA/QC

NOS Review/Audit of CAL operations March 13-15, 2002
CAL received the final report from the review team May 13, 2002
Draft response report to the NADP QA Manager and to the committees in September 2002
Final response report was delivered to the NADP QA Manager for review and distribution in February 2003

CAL and NADP web sites or hard copy by request

2001 CAL Quality Assurance Report
In progress and will be available at fall 2003 meeting

CAL Quality Assurance Plan – completed August 2002
CAL and NADP web sites or hard copy by request

SOPs
Yearly review on a timetable
Updates proceeding

Quality Assurance Programs (external programs)
USGS
Field Blank Samples (~100/year)
Blind Audit Samples (now SHE) (~100/year)
Interlaboratory Comparison Samples (26 sets/year, 4 per set)
National Water Research Institute, Burlington, Ontario (NWRI), Ecosystem Interlaboratory QA Program (2 sets per year, 10 per set)
World Meteorological Organization (WMO)/Global Atmospheric Watch (GAW) (2 sets per year, 3 per set)
Acid Deposition Monitoring Network in East Asia (EANET), NEW PROGRAM 2001
Norwegian Institute for Air Research (NILU), 1 sample set/year, 4 per set

Data Management Operations

Data to Program Office is on schedule!
NTN Data to PO through early November 2002
AIRMoN Data to PO through mid-December 2002

Site Information Database – completed
Information for all three networks (NTN, MDN, AIRMoN)
Includes contact, location, equipment, role, meetings attended, training courses attended, etc.
Programming by Larson, data entry and data entry/updates by CAL

Final Data Review Specialist (NTN) – Replacement hire
Support programmer (Dzurisin) retired Feb. 2003

Research

Organic and total nitrogen in NADP precipitation samples
CAL measures inorganic nitrogen (as nitrate and ammonium) in precipitation
Total nitrogen analysis minus inorganic nitrogen = organic nitrogen
NTN Chesapeake Bay samples are being split with Dr. Mark Castro (Univ. of Maryland, Center for Environmental Science Appalachian Laboratory at Frostbury, MD) to compare data between the two laboratories

Biohazards and microbes in precipitation
"Feasibility Study to Evaluate the Use of Precipitation Samples as an Effective Means of Monitoring the Environment for Naturally Occurring, Accidental, or Intentional Release of Bacillus anthracis and Other Toxic Agents" submitted to USDGS Innovation Fund by Bowersox, Harlin, Maddox (microbiologist), and Jones.
The proposal was not funded, however preliminary work was conducted.
CAL collected excess sample from 20 states west of the Mississippi
method development
preliminary investigations
Research

Sulfite and sulfate in AIRMoN samples
Jane Rothert is continuing to evaluate the underestimation of sulfate in winter AIRMoN samples due to the incomplete conversion of sulfite to sulfate.

CAL reports only sulfate
Results will be discussed at the fall 2003 meeting.

Research

Evaluation of bucket liners for NADP sampling
Considerable effort and expense in washing and shipping buckets to sites
Investment in buckets, and mailers to ship them in
Limits the ability of the network to investigate sampler designs that could improve the collection efficiency of blowing precipitation
A study protocol was developed to determine the feasibility of using plastic bucket liners for the NADP project and for new sampler design
Preliminary investigations completed/in-progress
Plastic Bag Liners for Sampler
March 2003 Status Report

Background
Plastic bucket liner could reduce costs:
- Buckets & supplies shipped to/from CAL in 15” x 15” heavy duty mailers
- mailers could be shipped less frequently
- Shipping costs are currently $7 to $25 one-way
- Reduce inventory costs (buckets & mailers)
- CAL must prepare and ship 300 buckets/week

Plastic liner could allow sampler redesign
- Current system:
  - 3.5-gal bucket 10” deep x 11.5” diameter (25cm x 29 cm)
  - depth/width aspect ratio - 0.9
- Other Systems:
  - 5-gal bucket 14.6” deep x 11.5” diameter (37 cm x 29 cm)
  - depth/width aspect ratio - 1.2
  - CAPMoN sampler 19.7” deep x 12.4” diameter (50 cm x 31.5 cm)
  - depth/width aspect ratio - 1.6
  - Prototype 20” deep x 10” diameter (50.8 cm x 25.4 cm)
  - depth/width aspect ration - 2.0

Research Goals
- Find a plastic bag with the physical characteristics of strength and the ability to conform to the container dimensions
- The bag must be chemically “clean” for the analytes of interest
- The bag must yield recovery of spiked samples which are consistent with current procedures
- Evaluate bags used by other precipitation networks (CAPMoN, NYS)
- Develop a working procedure to install liners in a field situation
- Perform preliminary field tests using paired samplers driven by a common sensor
- Estimate cost savings to networks if monthly or quarterly shipments of site suppliers were implemented

Update
Protocol: Decant into 1-liter bottles as done currently; not mail sealed bag to CAL
What’s been done?
- Tested a lot of bags with DI water and synthetic rain solutions
  - 50 mL solution added; decant after ~ 24 hours
- Results: Many bags rejected due to chemical contamination
  - Slip and antiblock chemicals added to polyethylene for processing
  - Many chemicals used
  - pH effects (increase or decrease seen)
    - Ca, Na, Cl, NH4 are biggest sources of contamination
- Field tested selected bags
  - ACM parallel samplers with independent sensors
  - ACM parallel samplers with common sensor

Update (continued)
Results from some likely candidates:
CAPMoN bags, polyethylene and Mylar (Vin Plastics, Ontario)
- Very clean, supplier developed special protocols for precipitation sampling
  - virgin PE, no additives (slip or antiblock), must have polyester for strength
  - Too rigid to conform to 3.5 gal bucket
  - Field tested. Only problems were primarily K (lid seal considerations?)
4 mil PE, clean room level 50 bags (Eastern States Packing, MA)
- Some memory effect when conforming to bucket shape with vacuum
  - Na ~ 15 ppb
  - NH4 loss (spike @ 80 ppb = 60 ppb, 75% recovery)
  - pH drop (DI target @ 5.6 = 5.4; spike target @ 4.96 = 4.88)
  - Field tested

Update (continued)
Results from some likely candidates:
CAPMoN lid bags, 2 mil polyethylene (Vin Plastics, Ontario)
- Na ~ 20 ppb
- Ca ~ 10 ppb
- Field tested, conforms well to bucket
Clean room polyethylene, 2 mil, (KNF Clean Room Products, NY)
- Very clean
- Only a small surface area tested , (5 x 5)
- Not field tested
Clean room Teflon (KNF Clean Room Products, NY)
- Very clean
- Very costly! (~$45 per bag)
Update (continued)

Results from some likely candidates:

FDA grade polyethylene, 3 mil (Rutan Polyethylene Supply & Bag Manuf. Co, New Jersey)
- ~ 5-10 ppb NH4
- Only a small surface area tested (8 x 4 x 8.5)
- Producer does not add anything, must come from supplier with additives; technical contact suspects that we could see an intermittent seasonal problem as humidity levels vary
- Producer wants to work with us but suggests that KNF may be a better source

What is recommended?

Teflon is idea but too costly (~$45 each)

Ideal polyethylene bag
- 3-6 mil and chemically “clean”
- Fit dimensions of sampler container well
- Consistent product quality for 16,000 bags/year

Dimensions to fit existing ACM or equivalent sampler
- 15.5” deep x 19 in. diameter
- Pail liner style bag needed
- Dimensions to fit new sampler design if 20” x 10”
  - 27” deep x 17.5” diameter

What is recommended?

Vin Plastics, Ontario
- Very clean, has worked with Canadian program to customize a suitable system
- Cannot make polyethylene bag w/mylar, but can make it w/thinner polyester film to reduce rigidity
- Has never made pail-liner style bag, but will evaluate the possibility
- Can taper the bottom for a flat style bag
- Cost for flat bag $0.80-$1.00 each

KNF Clean Room Products Corp, Ronkonkoma, NY
- Looks OK to date with 5 x 5 bag; they are sending a 20 x 24 bag to test
- QC includes cleaning resin when it arrives, using air showers to remove dirt from product, recleaning it prior to extruding. Used for some NASA applications
- Can do custom manufacturing
- Cost for NASA spec level 100 bag ~ $0.50 each
- Does not make a pail-liner style bag

What next?

Proceed with field testing a bag that will fit current sampler design (3.5 gallon bucket)?

Plan to get a clean, durable bag and wait until next collector design?
YES Inc. TPS 3000 Collector and Theis Clima optical sensor performance

YES Total Precipitation Sampler TPS 3000
- Flat reciprocating lid
- Strong DC drive motor
- Lid rest
- Holder to secure up to 5 gallon bucket
YES Total Precipitation Sampler
TPS 3000
Gold grid sensor
Logic circuitry inside sensor head
IRDA data port

Design Review
Sensor head too large for position
Design Review
- Sensor head too large for position
- Assembly procedure OK for prototype
- Materials of good quality
- Construction “fit and finish OK for prototype; sensor poor
- Power supply not acceptable (new one just received)

Operational Review
- Approximately 3.5 months of ISWS “backyard” time
- No freeze room or chemistry tests.
- Original unit replaced with YES test-collector on 3/11/03
Operational Review
- Sensor prone to icing

Operational Review
- Drive system prone to sticking system in open position after event (YES things it could be power supply, new power supply received)
Operational Review
- Sensor prone to icing
- Drive system prone to sticking
- System in open position after event (yes)
- IRDA port malfunction
- Drive motor "slap" increasing over time
- Power consumption not compatible with DC operation

Positive attributes
- STRONG DC MOTOR
Operational Review
- Positive attributes
  - STRONG DC MOTOR
  - GOOD LID POSITION CONTROL

In one sentence

At present the collector can not be relied upon to make wet-deposition only samples.
srd e-mail to YES 3/7/3

What’s the plan:
1) New TPS received and installed.
2) Although erratic lid motion has been noted within the first week of operation OF THE NEW UNIT, we will continue to work with Yankee.

What’s the plan:
3) It is worth note that YES feels that their responsibilities within PHASE II of the DOC SBIR have been fulfilled.
THEIS CLIMA OPTICAL SENSOR

**POSTIVES**

- Small compact design
- DIP switch settable
- Easy mounting

**NEGATIVES**

- 24 VDC operation
- Power out default opens collector
- Limited slit width reduces sensitivity to snow

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**THEIS CLIMA OPTICAL SENSOR**

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Adjusting slit width and switch off delay

The adjustment is set in the factory for 2-3 min intervals within 30 seconds with a switch off delay of 20 seconds. Adjusting the switch off delay and the number of slit intervals is set through the DIP switches and DIP switches.
THEIS CLIMA OPTICAL SENSOR
Small slit width and mass of slit depth does not allow for the extinct of laminar flow across the slit and for precipitation (especially snow with wind) to drop into the light path.

Light snow NW winds sustained

Slit width seems to allow for normal operation during light to moderate rainfall.
SUMMARY
Work with YES on improvements to design, operation of TPS 3000
Stop work on THEIS

BUT WAIT!!

improvements to design, operation of TPS 3000
Stop work on THEIS

THANKS to Roger Claybrook for the field work, data editing and slides.

NOTE: precipitation data taken from OTT Pluvio which (due to the nature of the DMAS) is late to report by ~ 15 minutes.

General “sensor” perspectives

THANKS to Roger Claybrook for the field work, data editing and slides.

Case 1 MODERATE SNOW
Case 2 LIGHT RAIN
Case 3 MODERATE RAIN
Case 1 MODERATE SNOW

Typically poor grid-plate sensor performance

CAPMON better than ACM but not as good as optical

Snow with little wind, THEIS and CAPMON OK

Two ETI's different but most sensitive

OTT seems to miss late event
Review catch data, Thanks to Van

**Case 2 LIGHT RAIN**

THEIS (purple) and ETI’s close (some ETI differences), some THEIS cycling

ACM last one out of the gate and missing event

**Case 3 MODERATE RAIN**

Review catch data
ACM misses light early events

CAPMON open more for early very light precip

THEIS carries event well past other opticals, water "roll off"?

Review catch values (ACM low)

WRAP UP/PLANS

Add 2 more ETI sensors (with NOAH III gages) to array, TOTAL OF 4.
WRAP UP/PLANS

Add 2 more ETI sensors (with NOAH III gages) to array TOTAL of 4
Run fine grid YES
Continue to run
Standard ACM
ETI ACM
ETI NCON
MIC
YES
Site operated since 1978 by U.S. Forest Service technician who follows Forest Service procedure, which calls for correcting Belfort gage measurements by NWS (stick) gage measurements. Each daily total and weekly total is adjusted by the ratio:

$$\frac{\text{Stick Gage Depth}}{\text{Belfort Gage Depth}}$$
CAL Standard Procedures
Precipitation Gage Data Review & Verification

Raingage charts are not routinely read and changed, unless:

- NOTE 9 - SAMPLE DEPTH does not compare well with PRECIPITATION DEPTH.
- NOTE 25 - SAMPLE DEPTH > PRECIPITATION DEPTH for more than half samples in report. Your gage appears to be undercatching. Please refer to your INSTRUCTION MANUAL, Appendix D for calibration check procedures.

- Sum of daily amounts does not equal total
- Precipitation type is recorded but no amount
- Total is zero, sample volume > zero, and the lid opened
- Total is missing and chart is present
- Operator reports difficulty reading chart or gage malfunction.
Questions/Discussion Points

- Should the Program Office report different (NTN and MDN) precipitation amounts from the same gage?
- If NO, what should the Program Office do to reconcile the differences?
- Should MDN site operators weigh the samples and compare the sample and precipitation depths?

Comparison of NTN bucket depths and NTN & MDN raingage depths

<table>
<thead>
<tr>
<th>Gage Amount</th>
<th>NTNbucket &gt; NTN &lt;sub&gt;average&lt;/sub&gt;</th>
<th>NTN &lt;sub&gt;average&lt;/sub&gt; &gt; MDN &lt;sub&gt;average&lt;/sub&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>= 0</td>
<td>50.6%</td>
<td>58.5%</td>
</tr>
<tr>
<td>&gt; 0 and ≤ 0.02</td>
<td>34.4%</td>
<td>54.1%</td>
</tr>
<tr>
<td>&gt; 0.02</td>
<td>32.1%</td>
<td>37.2%</td>
</tr>
</tbody>
</table>
Update
New Precipitation Gage Evaluations
Mark Nilles
U.S. Geological Survey

Phase I & II Testing Report
- Copies distributed at this meeting
  - “Evaluation of candidate rain gages for upgrading precipitation measurement tools for the NADP”, John Gordon, USGS
- Major findings
  - Ott Pluvio most reliable
  - Ott Pluvio and ETI NOAH II exhibited highest accuracy and precision

Phase III Test Report and Fact Sheet - Expect Within 8 Weeks
- Report and Fact Sheet on results from a collocated evaluation of the Ott Pluvio at 6 NTN sites for two years.
- Mary Tumbusch, USGS Nevada
  - Bottom line - Ott performed well with high reliability, accuracy and precision.
  - Problems:
    - occasional 0.01 inch false positives at several sites.
    - Significant user difficulties with DOS based laptop data transfer software and hardware.
    - Telemetry with Sutron GOES DCP did not work.

Little next step
- Test GOES satellite DCP interface and new operator interface software with latest Ott gage.

Proposed big next step (Between now and Fall meeting)
- Review Phase I-III USGS testing reports
- Evaluate GOES DCP interface and new user software
- Request ISWS prepare an independent report on the new rain gage performances at Bondville versus Belfort and stick gage.
At Fall 2003 meeting

- Present all summaries of testing to date
- Vote on the (draft) motion: Effective xx/xx/ 2004 the NADP shall adopt the Ott Pluvio or other new gage as the official precipitation gage. All new and relocated sites approved after this date shall install and utilize the new gage. Existing sites shall replace existing Belfort gages with the new gage by XX/200X.
Environmental Effects

New Orleans
Spring 2003
Introductions, Additions to the Agenda, Announcements

Old Business

Review review

Fall 2003 meeting

Ammonia workshop.

Issues

Isotope network
Ozone passive samplers
Plant and/or animal disease agents in precipitation. (eg anthrax).
Deposition AQRVs
Moving towards reporting Total N-Deposition
  Wet & dry, multi-species, point measurement – spatial allocation
  Total N
  Ammonia passive samplers
  Connecting deposition to sources
Developing mercury isopleth maps
  Network design, dry deposition
P – can/should we do better?

Brochures/data products

Produce a “Mercury in the Nation's Rain” product?
Other products?
  Host a workshop on long-term monitoring programs – ACS option
  Web forum for data producers and users
Quality Management Report

- Quality Management
  - Quality Management Plan
  - Network Quality Assurance Plans
- Quality Assurance
  - Laboratory Operations
  - Field Operations

Quality Management Plan: Status

- Initial draft completed in December 2002
- Reviewed by QAAG, Program Chair, others
- Review comments received were discussed Monday afternoon by QAAG
- Remaining issues will be discussed by Executive Committee at July 2003 meeting.
- Final draft for approval by Fall Technical Committee meeting.

Quality Management Plan: What’s in it?

- Introduction
- Management and Organization
- The NADP Quality System
  - Elements of Quality System
  - Planning (establishing Data Quality Objectives, etc.)
  - Documents and Records
  - Assessment and Response
  - Personnel Qualification and Training

Quality Management Plan: What else is in it?

- Procurement of Items, Services, and External Information
  - Items and Services
  - Computer Hardware and Software
- Implementation of Work
- Quality Improvement

Thank you for meeting Monday afternoon!
Changes proposed by QAAG: SOP Review and Approval

- Network SOPs (operations manuals) distributed for review by NOS 3 months before final approval
- Approved by Associate Coordinator and/or the Assistant Coordinator, the site liaison, and the QA Manager (remove laboratory manager, Program Coordinator, and the NOS chair)

Laboratory SOPs made available for review by the QA Manager
- Approved by the laboratory manager, laboratory QA officers, designated laboratory staff (remove approval of QA Manager)
- SOP changes must be submitted to the QA Manager

Changes proposed by QAAG: Confidentiality

- Remove any reference to confidentiality in NADP operations.
  - Provisional data handling policy in Network QA Plan

Changes proposed by QAAG: Assessments

- Assessment programs will be handled by QAAG.
- Does not change current programs:
  - Laboratory reviews
  - Quality Systems reviews
  - Data quality assessments
  - Site Systems & Performance Surveys
  - External QA Programs

Changes proposed by QAAG: Laboratory Reviews

- Schedule
  - External review every three years (CAL '02/HAL '03)
  - Internal review within one year after review report is received.
- Review Team
  - Team leader
  - Lab review (2 members appointed by NOS chair)
  - Data review (2 members appointed by DMAS chair)
  - QA Manager (observer)

Changes proposed by QAAG: Laboratory Reviews (2)

- Review Format
  - Are laboratory practices documented in the laboratory QAP and SOPs?
  - Do laboratory activities comply with QAP and SOPs?
  - Are procedures outlined in QAP and SOPs implemented effectively?
  - Do laboratory practices ensure that the data are of sufficient quality to meet DQOs and meet requirements outlined in SOW?
  - QAAG will propose checklist
Changes proposed by QAAG: Laboratory Reviews

- Review Reports
  - Report from review team: 30 days after review
  - Response from lab: 60 days after receiving report
- NOS and DMAS will approve the response within one month from date report received.
- Conflicts resolved by the QA Manager and Program Chair, in consultation with subcommittee chairs

Changes proposed by QAAG: Quality Improvement

- Responsibility for continued quality improvement in the NADP resides with the QAAG.
- NADP shall seek continued improvement of Data Quality Indicators (precision, bias, comparability, completeness, representativeness)

Changes proposed by QAAG: General Comments

- Statements of Work (SOW) should be reviewed to make sure that they comply with QA documentation.
- Evaluate structure ensuring that SOW requirements are met.
- Emphasis should include field operations, not just laboratory operations.

Network Quality Assurance Plans

- Revise current NTN, AIRMoN & MDN Plans
- Combine three existing network quality assurance plans (NTN, AIRMoN, MDN) into one NADP Network Quality Assurance Plan?
  - Maintain consistency across networks
  - Networks have common structure within NADP, avoid repetition
  - Separate parts discussing aspects unique to each network

Network Quality Assurance Plans: Goals

- Outline document by July 2003 Exec. Committee meeting
- Discuss and resolve inconsistencies in network procedures and quality assurance protocols in NOS at October 2003 meeting
- Prepare initial draft in time for 2004 Interim Subcommittee Meeting

Quality Assurance: Laboratory Operations

- 2003 CAL Followup Review
  - Completed by October 2003 Technical Committee meeting.
- 2003 HAL Review: June 10 – 12
  - Team leader: Mark Peden (retired)
  - Lab: Brooke Connor (USGS), Steve Lindberg (Oak Ridge NL)
  - Data: Chris Rogers (Harding ESE), Jim Lynch (Penn State)
  - Observer: Chris Lehmann (ISWS/NADP)
**Quality Assurance: Field Operations**

- Expansion of External QA Programs for MDN and AIRMoN
  - Discussed by QAAG
  - Exploring opportunities

**Site Systems and Performance Surveys: Remedial Actions**

- Program Office has received all reports from sites visited in 2002: 67 NTN, 20 MDN, 3 AIRMoN
- Electronic site sketches will be posted to NADP Internet site (31 prepared)
- Survey summary generated at Program Office from ATS database. Will be sent to site operators, supervisors, and sponsors.
### Site Inventory Ordered with Siting Criteria Violations

<table>
<thead>
<tr>
<th>Site</th>
<th>Azimuth</th>
<th>Description</th>
<th>Violation</th>
</tr>
</thead>
<tbody>
<tr>
<td>12.4</td>
<td>27°</td>
<td>EDGE OF HILL</td>
<td>Object is greater than 1m in height and within 5m of collector/raingage</td>
</tr>
<tr>
<td>10.8</td>
<td>99°</td>
<td>MET INSTRUMENT</td>
<td></td>
</tr>
<tr>
<td>11.9</td>
<td>98°</td>
<td>EDGE OF HILL</td>
<td></td>
</tr>
<tr>
<td>9.6</td>
<td>45°</td>
<td>EDGE OF HILL</td>
<td></td>
</tr>
<tr>
<td>10.9</td>
<td>106°</td>
<td>Belfort</td>
<td></td>
</tr>
<tr>
<td>10.8</td>
<td>111°</td>
<td>EDGE OF HILL</td>
<td></td>
</tr>
<tr>
<td>10.9</td>
<td>105°</td>
<td>EDGE OF HILL</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>108°</td>
<td>MET INSTRUMENT</td>
<td></td>
</tr>
<tr>
<td>10.7</td>
<td>109°</td>
<td>SERVICE BOX</td>
<td></td>
</tr>
<tr>
<td>9.3</td>
<td>105°</td>
<td>MET INSTRUMENT</td>
<td></td>
</tr>
<tr>
<td>10.4</td>
<td>109°</td>
<td>EDGE OF ACCESS ROAD</td>
<td></td>
</tr>
<tr>
<td>20.7</td>
<td>205°</td>
<td>EDGE OF ACCESS ROAD</td>
<td></td>
</tr>
<tr>
<td>9.9</td>
<td>209°</td>
<td>EDGE OF ACCESS ROAD</td>
<td></td>
</tr>
<tr>
<td>8.9</td>
<td>295°</td>
<td>EDGE OF ACCESS ROAD</td>
<td></td>
</tr>
<tr>
<td>4.5</td>
<td>277°</td>
<td>TOWER</td>
<td>Object is greater than 1m in height and within 5m of collector/raingage</td>
</tr>
</tbody>
</table>

### Other Issues

- Changes to External QA Programs (NOS)
- Establishing Data Quality Objectives (DMAS)
- CAL Data Minimum Reporting Limits (DMAS)
- Stick gage tolerance at AIRMoN sites (NOS)
- MDN/NTN raingage reporting discrepancies (NOS)
- Siting criteria changes (NOS)
Performance and Acceptance Criteria (PAC) / Data Quality Objectives (DQOs) for the NADP/NTN USGS EXTERNAL QUALITY ASSURANCE PROJECT

Greg Wetherbee: wetherbe@usgs.gov

Objectives of the USGS External QA Project
1. Estimate total error associated with NADP chemical measurements?
2. Determine portion of total error attributed to each step in the data-collection process?
3. Determine whether known and measurable sources of error are controlled to acceptable levels?
4. Determine what unmeasured sources of error can be identified, measured, and controlled?

USGS QUALITY ASSESSMENTS
1. Document past performance of laboratories, site operators, and field equipment in terms of absolute and relative error.
2. Document “trends” in performance from one year to next. Improving? No change?
3. Never state whether performance meets expectations. Good! Bad!

Example PAC for Intersite Program

<table>
<thead>
<tr>
<th>Data Quality Indicator</th>
<th>Measurement Quality Objectives for Performance Criteria</th>
<th>Acceptance Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Precision</td>
<td>100% within .02 pH Units, 1 µS/cm</td>
<td>&gt;90% within .05 pH Units, 2 µS/cm</td>
</tr>
<tr>
<td>Bias</td>
<td>Less Than +/- 5%</td>
<td>Less Than +/- 10%</td>
</tr>
<tr>
<td>Representativeness</td>
<td>4.0&lt;pH&lt;6.0, Sc &lt; 50</td>
<td>3.5&lt;pH&lt;6.5, Sc &lt; 100</td>
</tr>
<tr>
<td>Comparability</td>
<td>0.02 pH Units, 2 µS/cm</td>
<td>0.04 pH Units, 4 µS/cm</td>
</tr>
<tr>
<td>Completeness</td>
<td>100% Sites Respond</td>
<td>95% Sites Respond</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>0.02 pH Units, 1 µS/cm</td>
<td>0.04 pH Units, 2 µS/cm</td>
</tr>
</tbody>
</table>

Example PAC for Intersite Program

The Performance and Acceptance Criteria Process (PAC)
1. State the Problem
2. Identify the Study Questions
3. Identify Types of Information Needed
4. Establish Study Design Constraints
5. Specify Information Quality
6. Develop a Strategy for Information Synthesis
7. Optimize the Design for Collecting Information

USEPA, October 2002, EPA QA/G-4A, Peer Review Draft
Example PAC for Interlaboratory Program

<table>
<thead>
<tr>
<th>Data Quality Indicator</th>
<th>Measurement Quality Objectives for Performance Criteria</th>
<th>Acceptance Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Precision</td>
<td>2 f-pseudosigma</td>
<td>3 f-pseudosigma</td>
</tr>
<tr>
<td>Bias</td>
<td>0%</td>
<td>+/- 5%, No Trends</td>
</tr>
<tr>
<td>Representativeness</td>
<td>25th-75th NTN Percentile</td>
<td>10th-90th NTN Percentile</td>
</tr>
<tr>
<td>Comparability</td>
<td>Median Values 95% Accurate Compared to Target Values</td>
<td>Median Values 90% Accurate Compared to Target Values</td>
</tr>
<tr>
<td>Completeness</td>
<td>100% Lab Analyses</td>
<td>95% Lab Analyses</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>No ultrapure D.I. detections</td>
<td>&lt; 2 ultrapure D.I. detections</td>
</tr>
</tbody>
</table>

Example PAC for SHE and Field Audit Programs

<table>
<thead>
<tr>
<th>Data Quality Indicator</th>
<th>Measurement Quality Objectives for Performance Criteria</th>
<th>Acceptance Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Precision</td>
<td>5% Absolute Error</td>
<td>&lt;10% Absolute Error</td>
</tr>
<tr>
<td>Bias</td>
<td>0%</td>
<td>Less than +/-5%</td>
</tr>
<tr>
<td>Representativeness</td>
<td>Protocol performed correctly by all site operators</td>
<td>Greater than 90 percent site operators perform protocol correctly.</td>
</tr>
<tr>
<td>Comparability</td>
<td>2 f-pseudosigma of median concentration</td>
<td>3 f-pseudosigma of median concentration</td>
</tr>
<tr>
<td>Completeness</td>
<td>100% Samples Processed</td>
<td>&gt;90% Samples Processed</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>0.02 mg/L Absolute Difference</td>
<td>0.05 mg/L Absolute Difference</td>
</tr>
</tbody>
</table>

Example PAC for Collocated-Sampler Program

<table>
<thead>
<tr>
<th>Data Quality Indicator</th>
<th>Measurement Quality Objectives for Performance Criteria</th>
<th>Acceptance Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Precision</td>
<td>&lt;10% Absolute Error</td>
<td>&lt;25% Absolute Error</td>
</tr>
<tr>
<td>Bias</td>
<td>0%</td>
<td>Less than +/-10%</td>
</tr>
<tr>
<td>Representativeness</td>
<td>Less than 5 percent difference in sample volumes.</td>
<td>Less than 10 percent difference in sample volumes.</td>
</tr>
<tr>
<td>Comparability</td>
<td>Data for 2 samplers correlated &amp; within historic site data range</td>
<td>Data within range of historic data for site.</td>
</tr>
<tr>
<td>Completeness</td>
<td>100%</td>
<td>75% - Less than 13 weeks missed</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>Precipitation Depth: 0.02 inch, Concentrations: 0.02 mg/L, Absolute Difference</td>
<td>Precipitation Depth: 0.05 inch, Concentrations: 0.05 mg/L, Absolute Difference</td>
</tr>
</tbody>
</table>

The Data Quality Objectives (DQO) Process

7 Steps for DQO Planning Team

1. State the Problem
2. Identify the Decision
3. Identify the Inputs to the Decision
4. Define the Boundaries of the Study
5. Develop a Decision Rule
6. Specify Tolerable Limits on Decision Errors (e.g. \( \alpha = 0.05 \), \( \beta = 0.20 \))
7. Optimize the Design for Obtaining Data (e.g. cost effectiveness)

How are DQOs different from PAC?

...specify tolerable levels of potential decision errors that will be used as the basis for establishing the quality and quantity of data needed to support decisions. (USEPA, 2002)

How are DQOs and PAC related?

DQOs define the performance and acceptance criteria that limit the probabilities of making decision errors by considering the purpose of collecting the data; defining the appropriate type of data needed; and specifying tolerable probabilities of making decision errors. (USEPA, 2002)

Step 2: Identify the Decision(s)

Potential Decisions:

A) Constituent concentrations in precipitation are decreasing [or increasing].
B) NTN data quality is "acceptable."
C) Others?
Step 5: Develop Decision Rule(s)

...if, then statements

Potential Decision Rules:

A) If a Seasonal Kendall Test detects a negative [or positive] slope, then constituent concentrations in precipitation are decreasing [or increasing].

B) If median collocated-sampler [or substitute other program] absolute error is less than or equal to X% percent, then data quality is “acceptable.”

Step 6: Specify Tolerable Limits on Decision Errors

Step 6 determines:

A) How many samples need to be collected (N)
   …generally, N becomes larger as \( \alpha \) and \( \beta \) get smaller

B) Spatial distribution of samples (e.g. grid spacing)
   …generally, grid spacing tighter as \( \alpha \) and \( \beta \) get smaller

C) Temporal distribution of samples (e.g. seasonality)

Does the NADP/NTN Fit Into the DQO Process?

No:

DQOs:
DQOs define number (N), quality, and spatial/temporal distribution of samples required to make decisions with a pre-specified level of statistical confidence.

NADP/NTN:
Natural environment and funding control the number and spatial distribution of NTN samples. Therefore, \( \alpha \) and \( \beta \) would have to vary geographically. This complexity would limit spatial interpretation of the data.

DQOs:
DQOs are for making decisions about two clear alternatives (e.g. whether action levels are exceeded or not; clean precipitation vs dirty; etc.).

NADP/NTN:
Data analysis not always conducive to making yes/no decisions. Lots of “gray areas.” Probability of Type II error (\( \beta \)) would likely be high.
Data Quality Objectives: What do the Trends Show?

C. Lehmann

Objective

- Compare variability in data trends with measurement variability.
- Indicator of measurement system performance

Precipitation

Precipitation Trend (monthly averages, 1/94 - 9/02)

- Median Relative Difference
- Kendall Trends Test
- Seasonal Kendall Trends Test

Sulfate Concentration

Sulfate Trend (monthly averages, 1/94 - 9/02)

- Median Relative Difference
- Kendall Trends Test
- Seasonal Kendall Trends Test

Attachments:
17c, NADP Joint Subcommittee Minutes, Spring 2003
Attachment 17c, NADP Joint Subcommittee Minutes, Spring 2003
Review of NADP Siting Criteria

NOS Ad Hoc Committee
Rick Artz, Natalie Latysh, Chris Lehmann, Preston Lewis, Gary Stensland (chair)

Purpose of Committee
- Review and comment on the scientific foundation for the NADP siting criteria
- Suggest siting criteria changes to reflect the Quality Assurance needs of the NADP

Review
1. Looked at development of NADP criteria since 1978
2. Considered scientific foundation of NADP criteria
   - Made distinction between criteria and operating procedures
   - Noted some criteria only relevant to select analytes

Review
3. Articulated NADP Site Selection & Installation Manual into 33 separate criteria.
   A Criteria - To Minimize Influence of Anthropogenic Emission Sources to Air: Regional Requirements, > 10 km
   B Criteria - To Minimize Influence of Anthropogenic Emission Sources to Air: Local Requirements, < 10 km
   C Criteria - On-site Requirements, < 30 m, To Minimize Splash and Wind Flow Alterations
   D Criteria - Other Criteria Affecting Sample Representativeness

Progress
4. Reviewed 33 criteria
   (a) for changes in wording
   (b) to omit some of the 33 from the list
   (c) distinguishing criteria as
      - siting rules
      - siting guidelines
Issue #1: Distinguish Siting Rules from Siting Guidelines

**RULE** – Required compliance.
- Supported by scientific evidence of compromised data.
- New sites must seek exceptions from NOS
- Exceptions at new and existing sites shall be reported to data users (remedial action).

**GUIDELINE** – Desired, but not required, compliance.
- Implemented for general guidance
- Exceptions at new and exiting sites may be reported to data users

MOTION #1

The sitting committee moves that NADP siting criteria be classified either as “rules” or as “guidelines.”

MOTION #2

The sitting committee moves that new sites shall comply completely with all rules or seek exception by majority vote in NOS.

Issue #2: Upwind/Downwind Separation from Sources

- Omit upwind/downwind distinction for separation from industrial sources and population centers, taking largest distance.
- Uses wind rose data, which varies with season and may not reflect precipitation events.
  - (A1) Industrial sources, 10 km if site upwind, 20 km if site downwind
  - (A2) Urban areas, pop < 10,000, 10 km/20 km
  - (A2) Cities, pop > 75,000, 20 km/40 km

MOTION #3

The sitting committee moves that separation requirements for industrial sources and urban areas, outlined in Section 2.3.1 of the NADP/NTN Site Selection and Installation Manual, be changed to remove reference to wind direction. The separation shall be the largest distance indicated.

Revised wording

“Industrial operations such as power plants, chemical plants and manufacturing facilities should be at least 20 kilometers (km) away from the collector. If the emission sources are located in the general upwind direction (i.e., the mean annual west-east flow in most cases) from the COLLECTOR, then this distance should be increased to 20 km.”
Revised Wording

“This same criteria also applies to suburban/urban areas whose population approximates 10,000 people. For larger population centers (i.e., greater than 75,000) the COLLECTOR should be no closer than 40 km. This distance is doubled, to 40 km, if the population is upwind from the COLLECTOR.”

Issue #3: Criteria to Omit

Items that are general statements or that refer to procedures and not specific siting criteria.

MOTION #4

The siting committee moves to omit the following from the NADP Siting Criteria

- (D1) “Beyond 50 km both industrial and urban sources are generally assumed to blend in with the typical characteristics of the region.” (Section 2.3.1)
- (D2) “...consideration should be given to alternate sites in the event that the original site is no longer representative of the region.”
- (D4) “Changes or modifications to established or approved sites or to its equipment must be submitted to the Program Coordinator’s Office prior to implementation.”
- (B1-b) “The local road net around the site is of particular concern. Traffic volume and type will largely determine the impact of these types of sources on the site.”

Issue #4: Discussion of Wording Changes

- The siting committee proposes wording changes outlined on the handout for discussion in NOS

Issue #5: Rooftop Sampling

- Issues to Consider
  - Increased wind speed with height
  - Wind flow heterogeneity
  - Temperature fluctuations
  - Roof splash
  - Contamination (roof sewer vents, HVAC)
  - Data Heterogeneity

Rooftop Sampling—Impacts

- Wind effects influence raingage and collector catch efficiency
  - Rainfall reported not representative
  - Chemistry not representative
  - Contamination

Attachment 18, NADP Joint Subcommittee Minutes, Spring 2003
Rooftop Sampling Discussion

- Add wind shielding?
- Ways to control splash/contamination?

Future Direction of Committee

1. Finish rewording of siting criteria.
2. Propose if rules or guidelines
3. Study rooftop sampling further
4. Prepare new siting criteria list as part of NADP Network QA Plan, with separate section discussing technical basis for each criterion (Fall 2004).
Regionally Representative Sites

Two questions
- How do we determine which sites are regionally representative?
- What do we do with data from sites that are not regionally representative?

Siting Criteria
- Sites meeting all siting criteria are assumed to be regionally representative
- However:
  - variances allowed
  - regional criteria difficult to interpret
  - does not reflect differences between regions

Site Classification
- S-78-67-43-35-N
  - S = Suburban site
  - 78 = Population density within 15 km is greater than 78% of the continental US
  - 67 = Road density within 5 km is greater than 67% of the continental US
  - 43 = SO2 emission within 25 km is greater than 43% of the continental US
  - 35 = NOX emissions within 25 km is greater than 35% of the continental US
  - N = not within 100 km of an ocean

SO2 Emissions
### Site Classification

- **S-78-67-43-35-N**
  - **S** = Suburban site
  - **78** = Population density within 15 km is greater than 78% of the continental US
  - **67** = Road density within 5 km is greater than 67% of the continental US
  - **43** = SO2 emission within 25 km is greater than 43% of the continental US
  - **35** = NOx emissions within 25 km is greater than 35% of the continental US
  - **N** = not within 100 km of an ocean

### Regional Approach

- Criteria for regional representative sites vary by the region.
- Criteria can include:
  - Population density
  - SO2 Emissions
  - NOx Emissions
  - ??

### Bailey's Ecoregions

- Attached map showing Bailey's Ecoregions.

### SO2 Emissions

- Graph showing cumulative frequency of SO2 emissions.

- SO2 Emissions map for Central Appalachian and Nevada-Utah Mountains.
Proposal

- Site Classification – National comparison
- Regional Representative – Regional comparison
- Continue development
- Report at Fall meeting with suggested criteria

Sites not meeting regional criteria

- Flag all sites as being regional representative or not
- Sites that are not regionally representative
  - Show on isopleth map with a different symbol
  - not used for spatial interpolation

National vs Regional

<table>
<thead>
<tr>
<th>Site</th>
<th>SO₂</th>
<th>National %</th>
<th>Ecoregion %</th>
</tr>
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<tbody>
<tr>
<td>MA13</td>
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<td>CT15</td>
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<td>NC25</td>
<td>256</td>
<td>68</td>
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<tr>
<td>WV05</td>
<td>86</td>
<td>56</td>
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</table>
Minimum Reporting Levels for NADP Data

C. Lehmann, J. Rothert, B. Larson

Definitions

- **Method Detection Limit (MDL)**
  Limit at which measured concentration of a particular compound that can be distinguished from zero using a given analytical method
- **Minimum Reporting Level (MRL)**
  Level at which concentration of a particular compound can reliably be reported
  
  \[ \text{MRL} > \text{MDL} \]

**ISSUE**

The NADP has traditionally set MRLs (Minimum Reporting Levels) at approximately the MDL (Method Detection Limit) values for the NTN and AIRMoN.

- If MDL values did not vary significantly from year-to-year, MRLs were not changed.
- Values were called “MDLs,” even though really “MRLs”

**Discussion and Possible Motions…**

- CAL should determine MDLs based on EPA Method 40 CFR Part 136 at least annually (more often, as necessary)
- Long-Term MDL (LT-MDL) calculated annually based on 3-year average of bimonthly unfiltered FR10 measurements (blind to analysts).
- MRL be set at 2 to 3 times the LT-MDL, and re-evaluated annually by DMAS.

**Continued Discussion…**

- Beginning with 2003 NTN Data posted on the NADP web site either:
  - data shall be censored below the determined MDL (indicate <MDL)
  - all data will be reported, including negative numbers, with data below the MDL flagged
- Data between MDL and MRL be flagged

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**Calcium Data**

- Jul-78: 0.01
- Dec-78: 0.02
- Jan-79: 0.01
- Apr-79: 0.02
- Aug-80: 0.008
- Sep-80: 0.006
- Oct-80: 0.008
- Apr-81: 0.024
- May-81: 0.009
- Jan-00: 0.0082
- Jan-01: 0.0142
- Jan-02: 0.0145
- **AVERAGE**: 0.0127
- **MEDIAN**: 0.0142
- **MAX**: 0.024
- **MIN**: 0.006

---

**Graph**

- Calcium concentration over time (July 1978 to June 1981)
Long-term MDL (LT-MDL) calculated as average of FR10 blind analyses from 2000 - 2002

<table>
<thead>
<tr>
<th></th>
<th>Official &quot;MDL&quot;</th>
<th>LT-MDL</th>
<th>2xLT-MDL</th>
<th>3xLT-MDL</th>
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<tr>
<td>Mg</td>
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<td>0.006</td>
<td>0.009</td>
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<tr>
<td>Na</td>
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<td>0.006</td>
<td>0.012</td>
<td>0.018</td>
</tr>
<tr>
<td>K</td>
<td>0.003</td>
<td>0.006</td>
<td>0.012</td>
<td>0.018</td>
</tr>
</tbody>
</table>

Issues to address
- Historical data—Flag at MRL that is 3x MDLs indicated in 2000 CAL QA report?
- What to do about phosphate? Not part of FR10 matrix.

Data Censoring Discussion
- Percent of samples that fall below MDL

Calcium

Ammonium

Sulfate